Custom Power Solutions: Exploring the Efficiencies of a Stackable 3-Phase Brushless Motor Design

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The purpose of this experiment was to find if a power solution could be created that would allow for the adding of power by simply adding motors. The hypothesis states, “If I test a stack of 3 modular motors for peak efficiency by measuring the difference between input and output power, then the peak efficiency will be greater than or equal to 70%.” Custom mounting enclosures were designed that fit around the motors to allow them to be connected while keeping the position of the output shafts aligned to the rotor of the motor. By doing this, it was possible to connect the motor phases in parallel and increase output. The motors were tested by attaching them to a wooden board, then fixing a one-foot aluminum bar between the output shaft and a load cell. When the motor tries to turn, it enacts a force on the load cell that can be charted. The input power was measured by a VESC (Vedder Electronic Speed Controller). All data was then entered into a spreadsheet and graphed. The peak efficiency of a stack of 3 motors was 76%, so the hypothesis was supported. The larger commercial motor that was tested against had a slowly rising efficiency graph while the smaller stackable motors reached peak efficiency at just 8 amperes. Plans for further study include designing a motor dynamometer that would allow testing of the motors while spinning.